# Code Design of Non-binary Parity-Check Codes

**Master's Thesis**

## Project

Low-density parity-check (LDPC) codes are a prominent example of parity-check (PC) codes that are used in a large variety of applications. They were first proposed by Gallager together with a low-complexity message-passing decoder often called belief propagation (BP) decoder. LDPC codes with large block lengths can achieve low error rates and close to capacity performance. Yet, many low-latency communication systems, such as the internet of things, autonomous driving, or communicating control commands, require codes of short block lengths. For such codes, there is still a considerable gap between the performance of a BP decoder and the maximum likelihood (ML) decoder.

Recently, there has been active research to improve the decoding performance by using an automorphism ensemble decoder. Yet, the search for suitable automorphisms for decoding existing codes is challenging. Hence, different approaches investigate the design of linear codes with specifically designed automorphisms.

In this thesis, an algorithm to design non-binary as well as binary PC codes with suitable automorphisms should be developed and implemented. In addition, their performance should be evaluated and benchmarked with existing codes. Ideally, adaptions of the generalized AED considering the structure of the constructed codes should be proposed.

## Deliverables

1. Become acquainted with the automorphism ensemble decoder and non-binary channel codes

2. Development of an algorithm to design non-binary as well as binary PC codes with suitable automorphisms

3. Implementation and performance evaluation of a generalized AED for non-binary PC code

## Requirements

✓ Good skills in at least one programming language (e.g.. C++)

✓ Good knowledge of linear algebra, channel coding, LDPC codes and belief propragation decoding (CCAM/CCGBC)

## Institute

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